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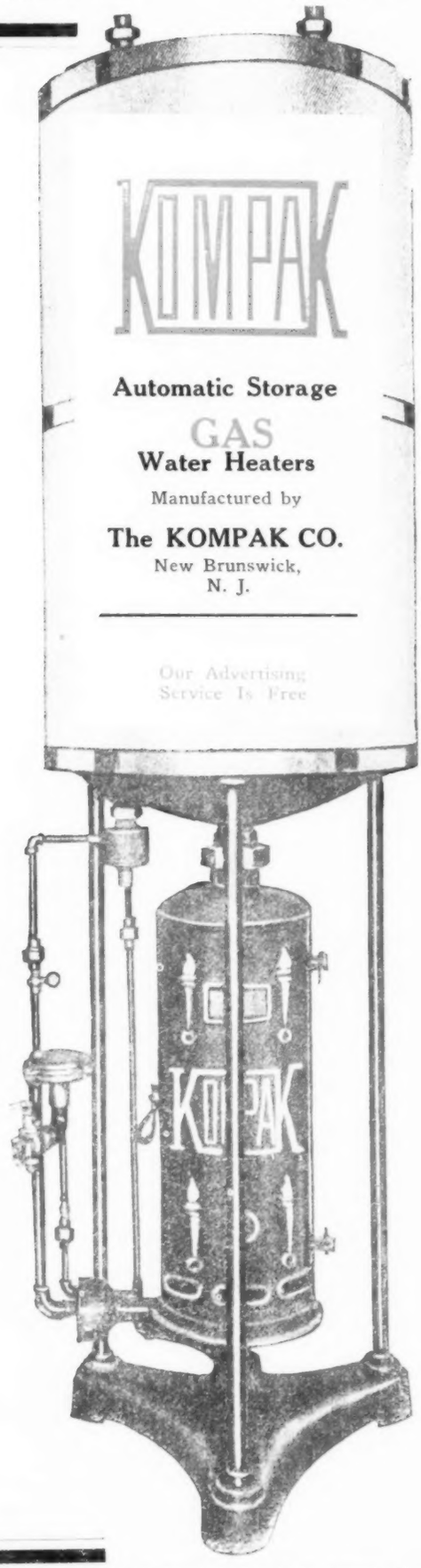


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FORMERLY THE AMERICAN GAS LIGHT JOURNAL

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# Gas as an Aid in Manufacture of Solders

## Use of Gas-Fired Furnaces by No Means as Common in This Field as It Should Be

By GILBERT C. SHADWELL

The use of gas-fired furnaces for the alloying of solders is by no means as common as it should be. In fact, there are splendid soft-metal furnaces on the market which are operated by gas; and those of the right sort, which are equipped with bottom outlets, are most valuable for this class of work, because they lend themselves admirably to the easy pouring of the metal into the molds. The time taken is considerably less than where the metal has to be ladled out, and the convenience and improved conditions to the operator are obvious.

The old-style furnaces with outlets consisted usually of a cock or spigot tapped into the bottom of the pot. Such an arrangement was had because it would freeze up rather readily, and if an extra burner was used to keep it hot the constant heating and cooling would cause the plug to work loose, which would bring about consequent leakage, to say nothing of a rather extravagant use of gas in the "pilot" for heating the outlet.

The style shown in Fig. 1 has several interesting features. The handle controlling the valve in the interior of the pot is arranged on a ball joint so that it can be set at whatever angle is most convenient to the operator. The outlet is always hot and always empty, except when metal is actually flowing. Hence it cannot freeze up. Where aluminum or its alloys is concerned this is particularly important. There is a joint at the top under the yoke, and there are adjusting screws near that point in order to take up any wear on the plunger which fits into the valve seat. Moreover, the plunger is very easily renewable if worn out. Those, then, are features of interest, as they have a distinct bearing upon the successful operation of any work to be carried out, such as older manufacture.

The writer feels that is very desirable at this point to give some tables of solders which will be found not only valuable as references but should likewise be studied so that the nature of them may be properly understood and appreciated.

TABLE OF SOLDERS

| Name of Solder | Composition |
|---|---|
| Soft, coarse | Tin, 1; lead, 2. |
| Soft, fine | Tin, 2; lead, 1. |
| Soft, fusible | Tin, 2; lead, 1; bismuth, 1. |
| Pewterer's | Tin, 3; lead, 4; bismuth, 2. |
| Spelter, soft | Copper, 1; zinc, 2. |
| Spelter, hard | Copper, 2; zinc, 1. |
| Silver, fine | Silver, 66.6; copper, 234; zinc, 10. |
| Silver, common | Silver, 66.6; copper, 30; zinc, 3.4. |
| Silver, for brass iron | Silver, 1; brass, 1. |
| Silver, more fusible | Silver, 1; brass, 1; zinc, 1. |
| Gold, for 18-karat gold | Gold, 18 karats fine, 66.6; silver, 16.7; copper, 16.7. |
| Gold, more fusible | Same as above, with trace of zinc. |
| Platinum | Fine gold. |

| Material to Be Soldered | Solder | Flux |
|---|---|---|
| Tin | Soft, coarse or fine | Rosin or zinc chloride |
| Lead | Soft or coarse | Rosin |
| Brass, copper, iron & zinc | Soft or coarse | Zinc chloride |
| Pewter | Pewter's or fusible | Rosin or zinc chloride |
| Brass | Spelter or soft | Borax |
| Copper and iron | Spelter, soft or hard | Borax |
| Brass, copper, iron & steel | Any silver, S. | Borax |
| Gold | Gold, S. | Borax |
| Platinum | Fine gold | Borax |

It must naturally be understood that only the low or medium temperature solders can be handled in a regular 900 deg. Fahr., or slightly over should be taken care of by the aid of a crucible furnace of suitable design.

The following table gives the fluxing point of certain solders, as well as the flux. The letter R stands for rosin, B for borax and Z for zinc chloride.

| No. and Name of Solder | Composition | Flux | Fluxing Point |
|---|---|---|---|
| 1—Plumber's coarse | Tin 1, lead 3 | R | 800° F. |
| 2—Plumber's sealed | Tin 1, lead 2 | R | 441° F. |
| 3—Plumber's fine | Tin 1, lead 2 | R | 370° F. |
| 4—Tinner's | Tin 1½, lead 3 | R or Z | 334° F. |
| 5—Tinner's fine | Tin 2, lead 1 | R or Z | 340° F. |
| 6—Hard, for brass & iron | Cop. 2, zinc 1 | B | .. |
| 7—Hard, for copper, brass and iron | Good tough brass | B | .. |

| | | | |
|---|---|---|---|
| 8—Hard, for copper, brass and iron | Zinc 1, cop. 1 | B | .. |
| 9—Hard, for copper, brass and iron. More fusible than Nos. 6 and 7 | Zinc 1, tough plate brass | B | .. |
| 10—Silver, for jewelers | Sil. 19, cop. 1 | B | .. |
| 11—Silver, for silver, brass and iron | Sil. 1, brass 1 | B | .. |
| 12—Silver, for silver, brass and iron | Sil. 1, brass 1 | B | .. |
| 13—Silver, for steel joints | Sil. 19, cop. 1 | B | .. |
| 14—Silver, non-fusible | Brass 1, sil. 5 zinc 5 | B | .. |
| 15—Gold | Zinc 5, gold 12, silver 2 | B | .. |
| 16—Bismuth | Cop. 4, lead 4, tin 4 | R or Z | 320° F. |
| 17—Bismuth | Bis. 1, lead 2, tin 2 | R or Z | 310° F. |
| 18—Bismuth | Bis. 1, lead 2, tin 2 | R or Z | 292° F. |
| 19—Bismuth | Bis. 1, lead 2, tin 1, bis. 2 | R or Z | 236° F. |
| 20—Bismuth | Lead 3, tin 5, bismuth 3 | R or Z | 202° F. |
| 21—Pewterer's | Lead 4, tin 3, bismuth 2 | R or Z | .. |

Concerning brass solders, the following list will give some of the more common ones employed:

TABLE OF BRASS SOLDERS

| Style of Brass Solder | Copper | Zinc | Tin | Lead | Color |
|---|---|---|---|---|---|
| Very strong | 58 | 42 | .. | .. | Reddish yellow |
| Strong | 53 | 47 | .. | .. | Reddish yellow |
| Medium | 50 | 50 | .. | .. | Reddish yellow |
| Medium | 54½ | 43½ | 1½ | ½ | Reddish yellow |
| Easily fusible | 34 | 66 | .. | .. | White |
| Easily fusible | 44 | 50 | 4 | 2 | Gray |
| White | 57 | 28 | 15 | .. | White |

It might be mentioned at this point that the best solder for platinum is fine gold. This joint is not only very infusible but it is not easily acted upon by common agents. For German silver joints an excellent solder is composed of equal parts of silver, brass and zinc. The proper flux is borax.

Concerning the composition of solders for special purposes the following table is of interest, and as the melting points are even it will be easy to see which can be melted in the regular soft metal furnaces:

TABLE OF SOLDERS FOR SPECIAL PURPOSES

| Solders | Gold | Silver | Copper | Tin | Zinc | Lead | Bismuth | Brass | Melting Point |
|---|---|---|---|---|---|---|---|---|---|
| Pewterer's | .. | .. | .. | 2 | .. | 1 | 2 | .. | 360° F. |
| Pewterer's soft | .. | .. | .. | 3 | .. | 4 | 1 | .. | .. |
| Pewterer's soft | .. | .. | .. | 2 | .. | 1 | .. | .. | .. |
| Tinman's | .. | .. | .. | 1 | .. | 1 | .. | .. | 393° F. |
| Coarse | .. | .. | .. | 1 | .. | 3 | .. | .. | 500° F. |
| Plumber's | .. | .. | .. | 1 | .. | 2 | .. | .. | 475° F. |
| Hard spelter | .. | .. | 4 | .. | 3 | .. | .. | .. | 1869° F. |
| Gold | 6 | 1 | 2 | .. | .. | .. | .. | .. | .. |
| For brazing steel | .. | 19 | 1 | .. | .. | .. | .. | 2 | .. |
| Harvest steel | .. | 4 | 1 | .. | .. | .. | .. | .. | .. |
| Hard silver | .. | 3 | .. | .. | .. | .. | .. | 1 | .. |
| Soft silver | .. | 2 | .. | .. | .. | .. | .. | 1 | .. |
| For aluminum | .. | 2 | .. | 2 | 1 | 2 | .. | .. | .. |

Solders for gold work are not met with so frequently as those mentioned above, but they are none the less important. They consist of white and colored solders and may be tabulated as follows:

WHITE SOLDERS FOR GOLD WORK

| No. and Name of Solder | Fine Silver (parts) | Copper (parts) | Spelter (parts) | Fusing Point |
|---|---|---|---|---|
| 1—Hard silver | 16 | 3½ | ½ | 1866° F. |
| 2—Medium | 15 | 4 | 1 | 1843° F. |
| 3—Easy | 14 | 4½ | 1½ | 1818° F. |
| 4—Common hard | 12½ | 6 | 1½ | 1826° F. |
| 5—Common easy | 11½ | 6½ | 2 | 1802° F. |

COLORED SOLDERS FOR GOLD WORK

| No. and Name of Solder | Fine Gold (parts) | Fine Silver (parts) | Short Copper (parts) |
|---|---|---|---|
| 1—Best gold | 12½ | 4½ | 3 |
| 2—Medium gold | 10 | 6 | 4 |
| 3—Common gold | 8½ | 6½ | 5 |

We have given details of some of the silver solders in preceding tables, but for convenience a complete tabulation is given below:

SILVER SOLDERS

| No. and Name of Silver Solder | Fine Silver oz. | Fine Silver dwt. | Short Cop dwt. | Short Cop gr. | Brass dwt. | Zinc dwt. | Zinc gr. | Arsenic dwt. | Arsenic gr. | Composition dwt. | Composition gr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *1—Hard silver | 1 | 0 | 5 | 0 | .. | .. | .. | .. | .. | .. | .. |
| 2—Hard | 1 | 0 | .. | .. | 6 | 16 | .. | .. | .. | .. | .. |
| 3—Easy | 1 | 0 | .. | .. | 10 | .. | .. | .. | .. | .. | .. |
| 4—Best hard | 1 | 0 | 4 | 9 | .. | .. | .. | 15 | 0 | .. | .. |
| 5—Medium | 1 | 0 | 5 | 8 | .. | 0 | 1 | 8 | 0 | .. | .. |
| 6—Easy | 1 | 0 | 6 | 12 | .. | 0 | 2 | 4 | 0 | .. | .. |
| 7—Common | 1 | 0 | 9 | 15 | .. | 0 | 2 | 9 | 0 | .. | .. |
| 8—Enameling | 1 | 0 | 5 | 0 | .. | .. | .. | .. | .. | .. | .. |
| *9—Enameling | 1 | 0 | 10 | 0 | .. | .. | .. | .. | .. | .. | .. |
| *10—Filigree | 0 | 16 | 0 | 12 | .. | .. | .. | .. | .. | 3 | 12 |
| 11—Quick running | 1 | 0 | .. | .. | .. | .. | .. | 0 | 20 | 10 | 0 |
| *12—Chain | 1 | 0 | 10 | 0 | .. | 0 | 2 | .. | .. | .. | .. |
| 13—Easy chain | 1 | 0 | .. | .. | .. | 0 | 2 | .. | .. | 10 | 0 |
| *14—Common | 1 | 0 | 12 | 0 | .. | 0 | 3 | .. | .. | .. | .. |
| 15—Common easy | 1 | 0 | .. | .. | .. | 0 | 3 | .. | .. | 12 | 0 |
| 16—Very common | 1 | 0 | .. | .. | .. | .. | .. | 0 | 1 oz. | 1 oz. | 0 |

*Silver ladders which are recommended for special work.
Oz. = ounces; dwt. = pennyweights; gr. = grains.

## Detailed Formulae for Solders

*Soft Solders*—Soft solders or tin solders can be used to solder many different metals, such as gold, silver, lead, copper and steel, as well as brass, wrought iron and zinc. Its principal use, however, is in ordinary tinsmith's work, for which tin plate, zinc and sheet brass are the materials most frequently employed. Soft solder can be used for any purpose where the soldered articles need not be heated much above the boiling point of water (212 deg. Fahr.), so that there is no danger of its melting.

For ordinary tinsmith's work, where the resistance of the solder to acids, etc., is of less importance, it is customary to use mixture of tin and lead in varying proportions, according to different purposes and according to the required melting point of the solder. Experts have taken much pains to make accurate determinations in this important matter, and the following table gives the fusing point in degrees centigrade of a solder containing a certain amount of lead to 100 parts of tin:

| Lead | Fusing Point (Deg. Cent.) | Intensity of Alloy |
|---|---|---|
| 16.5 | 194 | 7.927 |
| 30 | 194 | 7.994 |
| 33.3 | 194 | 8.109 |
| 40 | 194 | 8.234 |
| 45 | 187 | 8.267 |
| 50 | 187 | 8.408 |
| 60 | 181 | 8.447 |
| 66.6 | 181 | 8.726 |
| 100 | 197 | 8.864 |
| 119 | 197 | 9.038 |
| 125 | 197 | 9.270 |
| 179 | 210 | 9.433 |
| 200 | 235 | 9.554 |
| 233 | 235 | 9.640 |
| 250 | 235 | 9.770 |
| 268 | 243 | 9.797 |
| 300 | 246 | 9.939 |
| 358 | 246 | 10.052 |
| 536 | 270 | 10.331 |
| 715 | 283 | 10.595 |
| 880 | 292 | 10.751 |
| 1072 | 292 | 10.815 |

It will be seen that the alloys of tin and lead become denser and less readily fusible as the contents of lead are increased.

According to other experiments, the fusing points of the alloys are as given below:

| Lead | Tin | Fusing Point (Deg. Cent.) |
|---|---|---|
| 207 | 118 | 189 |
| 207 | 354 | 180 |
| 207 | 708 | 190 |
| 621 | 236 | 211 |
| 1242 | 118 | 270 |

Before the solders really melt they soften considerably, and the following table gives the softening point of some alloys:

| Lead | Tin | Softening Point (Deg. Cent.) | Melting Point (Deg. Cent.) |
|---|---|---|---|
| 1035 | 236 | 185 | 189 |
| 1242 | 236 | 189 | 194-195 |
| 1449 | 236 | 192 | 198 |
| 1657 | 236 | 202 | 208-210 |

Some alloys used specially for solders are:

| Lead | Tin | Fusing Point (Deg. Cent.) |
|---|---|---|
| 1180 | 4140 | 240 |
| 1180 | 3105 | 223 |
| 1180 | 2070 | 200 |
| 1180 | 1242 | 181 |
| 1180 | 1035 | 185 |
| 1180 | 828 | 190 |

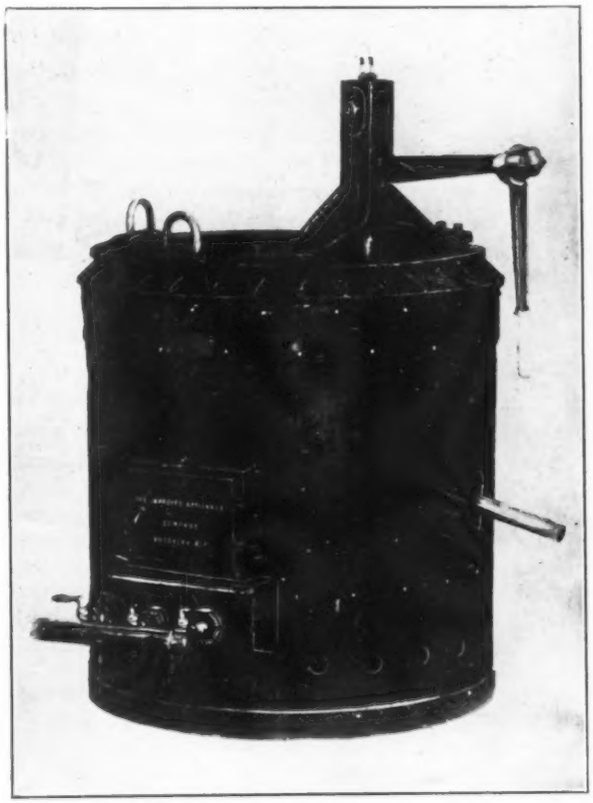

Fig. 1

The composition of ordinary soft solder is often given as lead 207 and tin 118 parts. Others are: Weak soft solder, lead 207 parts and tin 236 parts; strong soft solder, lead 414 and tin 118 parts. Fluid solder is stated by one authority to be lead 621 parts and tin 590 parts.

Fluid solder is prepared by making the given mixture and letting it stand until partially hardened, when the part which is still fluid is poured off.

If the alloys are to be made in small quantities it requires very sensitive scales to weigh the metals accurately. The composition of some varieties of tin solder is given below (in round numbers), with the fusing point of each. They are numbered according to their fluidity, No. 1 being the hardest.

1. Lead, 2; tin, 1; fusing point, 240 deg. Cent.
2. Lead, 1; tin, 1; fusing point, 200 deg. Cent.
3. Tin, 2 to 2½; lead, 1; fusing point, 185 to 190 deg. Cent.
4. Lead, 10; tin, 17; fusing point about 180 deg. Cent.

For some purposes even the soft solders of tin and lead are too difficult of fusion, and in this case alloys of tin, lead and bismuth are employed. This is a most

excellent solder, but its use is limited to very special purposes on account of the high price of bismuth. For ordinary work also there is no need of such an extremely low fusing point.

### Hard Solders

In treating of soft solders it was shown that the fusing point of these compositions varies considerably. The variations are still greater in the case of hard solders, whose composition is such that they melt only on being brought to strong red heat. Some of them can be melted in the ordinary way with the aid of a soldering iron, while in the case of others a brazing burner using gas with air under pressure must be used, or the whole object to be soldered or brazed must be strongly heated. The numerous kinds of hard solders with different fusing points are made necessary by the difference in the nature of the various metals and metallic compositions which may require soldering.

Of yellow hard solders we have:

1. Very hard—(a) Appelbanius compositions, consisting of copper 58 and zinc 42 parts; (b) Sheet brass 85.42 parts and zinc 13.58 parts; (c) Karmarsch's composition, which consists of brass 7 parts and zinc 1 part; (d) Prechtl's composition, consisting of copper 53.30 parts, zinc 43.10, tin 1.30 and lead 0.30 parts.
2. The foregoing compositions have the yellow color of brass, are very strong and require very high temperatures for melting, so that they can be used for copper, steel and all kinds of iron.

The ones next given melt more easily than the first and are suitable for all kinds of work with brass: (a) Sheet brass 81.12, zinc 18.88; (b) Copper 54.08, zinc 45.29; (c) Brass 3 to 4, zinc 1; (d) Brass 78.26, zinc 17.41, silver 4.33. This is somewhat expensive on account of the silver, but has the valuable property of being at once tenacious and ductile, and can be worked into wire with hammer or rollers.

3. Still softer are: (a) Brass 5, zinc 2.5; (b) Brass 5, zinc 5.

We next come to the half white solders, of these we have: (1) Copper 53.3, zinc 46.7; (2) Brass 12, zinc 4 to 7, and tin 1; (3) Brass 12, zinc 10, and tin 1; (4) Copper 44, zinc 4, tin 3.20, and lead 1.20.

That marked No. 1 which is called Volk's hard solder and No. 4 Prechtl's half white are quite readily fusible. Finally we have the white type of solder of this kind: (1) Brass 20, zinc 1, tin 4; (2) Brass 11, zinc 1, tin 4; (3) Brass 6, zinc 4, tin 10; (4) Copper 57.44, zinc 27.8, tin 4.58.

The following table gives a list of these solders prepared from the pure metals:

| Name of Solder | Copper | Zinc | Tin | Lead |
|---|---|---|---|---|
| Very hard | 57.94 | 42.06 | .. | .. |
| Very hard | 58.33 | 41.67 | .. | .. |
| Hard | 50.00 | 50.00 | .. | .. |
| Soft | 33.34 | 66.66 | .. | .. |
| Soft, half white | 44.00 | 49.90 | 3.30 | 1.20 |
| Soft, white | 57.44 | 27.98 | 14.59 | .. |
| Soft | 72.00 | 18.00 | 4.00 | .. |
| Soft, Volk's | 53.30 | 46.70 | .. | .. |

The best next gives a list of solders of brass and zinc:

| Name of Solder | Brass | Zinc | Tin |
|---|---|---|---|
| Very hard | 85.42 | 12.58 | .. |
| Very hard | 7.00 | 1.00 | .. |
| Hard | 3.00 | 1.00 | .. |
| Hard | 4.00 | 1.00 | .. |
| Soft | 5.00 | 2.00 | .. |
| Soft | 5.00 | 4.00 | .. |
| Half white | 12.00 | 5.00 | 1.00 |
| Half white | 44.00 | 20.00 | 2.00 |
| White | 40.00 | 2.00 | 8.00 |
| White | 22.00 | 21.00 | 4.00 |
| White | 18.00 | 12.00 | 30.00 |
| Very ductile | 78.25 | 17.00 | .. |
| For brazier's work | 81.12 | 18.00 | .. |

The following are brass solders only:

| Name of Solder | Copper | Zinc | Tin | Lead |
|---|---|---|---|---|
| Yellow, hard | 53.30 | 43.10 | 1.30 | 0.30 |
| Half white, soft | 44.00 | 49.90 | 3.30 | 1.20 |
| White | 57.44 | 27.98 | 14.50 | .. |

### German-Silver Solders

The solders thus classified, as their names implies, are used principally for soldering German silver. This alloy contains nickel and is very hard and white, and it requires solders which have corresponding qualities. German silver belongs among the alloys which are very difficult of fusion, and the solders used for it are those which have very high fusing points and belong, therefore, to the general class of hard solders. They have just strength, and are used for other purposes in cases where the object to be soldered is exposed to heavy strain. German-silver solder can be given a color very much like that of steel, and is much used in steel work.

In regard to its composition, it bears this relation to ordinary hard solders, that while these may be considered to be brass with a mixture of zinc, German-silver solder may be called a mixture of zinc and German-silver solder. It is softer or harder according to the greater or less amount of zinc contained in it, but if this exceeds a certain limit, the solder becomes very brittle.

These are two principal varieties of German-silver solder, called relatively hard and soft. The former is exceedingly strong on account of the larger amount of nickel it contains, and is sometimes called "steel solder," being generally used for soldering steel.

Of the soft German-silver solders we have the following: (1) Copper 4.5, zinc 7.0, nickel 1.0; (2) Copper 35.0, zinc 56.5, nickel 8.5; (3) German silver 5, zinc 4.

Nos. 1 and 2 are quite similar in composition and have correspondingly similar properties; in No. 3 German silver (which consists of a compound of copper, zinc and nickel) is used directly, and in preparing this solder it is necessary to know the exact composition of the alloy, or to try the solder in small quantities in order to be sure of the correct amount of zinc to be added. It may be assumed that the proportions are correct when the metallic mixture is lustrous, and fusible enough to allow of pulverizing when hot and when it will become fluid in contact with a red hot soldering iron.

Hard German-silver solders or steel solders as they are sometimes called are: (1) Copper 35, zinc 56.5,

(*Continued on page* 111.)

# Present Tendency Upwards in Prices Began Quarter of a Century Ago

## W. F. Gephart Points Out Custom as an Enormously Strong Price Control Factor—How Capital Yields Demanded Have Increased

One of the most interesting facts in economic history is that prices pass through periods extending over several years in which the level is upwards or downwards. While ordinary observations disclose great irregularity in the price of a particular commodity over short periods of time, yet careful investigation shows that prices in general are subject to this upward and downward trend, declares W. F. Gephart, of the First National Bank in St. Louis, in a recent paper. There is no agreement as to any one cause producing these cycles of prices. The significant fact is that ever since there has been money, certain forces operate to produce this change in the levels. We are now in the midst of one of these remarkable cycles. Beginning with 1897, the price level has been upwards, and the forces producing this effect, have been accelerated by the World War. Commodity prices in 1860, taken as 100, had increased to 130 by 1915, and by the close of the war they had reached 230. This was the case in the United States, and a similar result is shown in all other nations. These price changes are disclosed by the various index numbers, which are the only scientific method of measuring changes in prices.

These index numbers show what is happening to prices in general.

Particular prices may increase or decrease over short period of time. Some prices may not advance as rapidly as other prices, for the forces determining a single price, may in some respects be peculiar to it.

For example, when monopoly exists, that is, when there is control over the supply, a larger degree of control over the price is possible. Likewise, when there is governmental control, the change in price is likely not to follow so closely the general upward tendency. This is especially true if the government regulation is of an essential, and one for which the public is accustomed to paying a certain price. Custom is an enormously strong force in controlling prices and governmental regulation only adds another force to restrain any change in prices.

This combined condition of customary price and governmental regulation, is found in the case of public utilities. The people become accustomed that private capital is invested in public utility properties just as in private corporations. This capital is subject to business risks as in a private enterprise.

It is taxed.

Its return is controlled by the State by largely inflexible rates. In short, the same considerations which determine the flow or investment of capital in any business, govern the investment of capital in this field.

Capital is not sentiment.

It is not an emotional thing, governed by the motives of the hearth and home.

It is selfish.

It has neither pity nor pain.

It goes where it can secure the best return for itself.

It forsakes its oldest friends at the least suggestion of sacrifice.

What is the situation then of many of our public utilities under prevailing conditions of an increasing price level, a regulated rate of return, or price, an unsympathetic public, a selfish capital, seeking as always, the best possible investment with an increasing number of bidders for the use of capital and a decreasing amount of capital for sale?

### Refusal of New Capital to Flow Into Utility Field

In the first place, there is a tendency towards a deterioration of the physical plant and force. Private industry producing its product for a sellers' market—that is, at high prices—is able both to pay more for materials and to pay higher wages to employees.

In the second place, extensions cannot be made with accustomed and desirable regularity due to the high prices and dearth of material and labor, the reduced earnings, and the lack of new capital. Public utility corporations operate very largely under the law of increasing returns; that is, the net returns on increased units of service is greater than the proportional outlay required to furnish this increased service.

In the third place, the most significant of all the effects, is the refusal of new capital to flow into this field. A period of rising prices brings many opportunities to capital to receive a higher rate of interest, for it must never be forgotten that the rate of a return is a price—the price of capital—and like all other prices, should and must advance if capital is to be forthcoming. There is a cost of money just as there is a cost of wheat or pig iron.

### Determining the Cost of Capital

In endeavoring to establish the cost of money to industry, a number of factors must be taken into consideration. The cost of capital at any one time is determined in a large measure, by the available supply of capital. If one were to endeavor to determine the relative supply of capital over a long period of years, the best index for measuring this would in all probability be found by investigating the yield on a large number of high grade securities.

Ordinarily it would be fairly safe to assume that when the average yield on a large number of such securities is high, the available supply of capital must necessarily have been considerably limited or at least inadequate to the demand existing at that time. The yield afforded by securities of this type is probably the only criterion by which the demand and supply for capital can be determined. Since the price of any one bond, or a commodity for that matter, is likely to be influenced by special causes peculiar to itself, deductions of this nature can be made only by averaging a number of representative bonds, indicative of various types of industry. In the case of bonds, computations representing the average yield, are rendered difficult by

the fact that every bond has a date of maturity when it will be redeemed at par value. Therefore, when a bond is selling at a discount, its price tends to gradually rise to par, regardless of the demand and supply of capital. Thus, the average price of bonds is not nearly as significant as is the average yield to maturity. The average bond yield is in its general movements opposite to the bond price. That is, the higher the price of the bond, the lower the yield. It is quite obvious that the average investment yield obtainable from bonds or loans, depends primarily upon the supply of capital as compared with the demand for it.

If one were to examine the conditions affecting bond yields and money rates, over a considerable period of time it would be necessary to take into consideration the more important factors affecting capital during the period. In ordinary usage the terms, money and capital, are confusing and are used rather indiscriminately. On this point, even bankers and men of long experience in financial affairs are often hazy.

Strictly speaking, capital should be considered primarily as that part of wealth used in the production of additional wealth. Capital, unlike wealth, is dynamic, not static. It is the product of industry that has been saved or accumulated, which has been set aside or stored up in such a way as to be of aid in further production. Ordinarily we might consider that capital is that portion of the annual increment which is used to increase or further production. The supply of capital available at any time depends upon a number of considerations—

First The amount of labor productively employed. Capital can only be accumulated when there is a surplus of production. The efficiency of labor, is of course, a large factor in this regard.

Second: The use to which the surplus products of the nation are being put is a vital factor in regard to the available supply of capital. If this surplus is being used for current consumption—for food, clothing, luxuries, pleasures, etc.—the surplus products of industry fail to increase the supply of available capital. If the surplus is being invested in tools, equipment, and improvements which will bring an ultimate return in the form of increased production, the surplus naturally increases the supply of capital. Normally, the total capital fund of the nation circulates rather rapidly. While the total remains, or rather is, gradually increasing, its component parts are continually changing.

### Capital Equipment Can Be Maintained Only by Constant Replacement

Capital equipment can be maintained only by constant replacement of wornout parts, and by additions and improvements to meet the increased demand being placed upon it by the growth and development of the nation. No capital investment can ever hope to be permanent. Even the Roman viaducts, which are perhaps the most permanent investment of capital afforded by history, eventually fell into disrepair. This represents an extreme type of capital investment. Most forms of capital investments are very short lived and must be replaced in their entirety in a comparatively short space of time. The result is, that a large percentage of the annual increment of business must be put back into the business immediately in order to maintain the efficiency of the machine as a whole.

Experience shows that raising commodity prices are accompanied by a rate in bond yields. Superficially, the cause for this would seem to lie in the fact that with rising prices the investor, finding his real income reduced, would demand a larger return for the use of his capital and hence bond yields would tend to rise. Another factor entering into the situation lies in the fact that with a rise in commodity prices, the demand for capital must necessarily increase, as the higher prices require a larger volume of capital in the conduct of business. Likewise, during a period of falling commodity prices, the situation is reversed, so that bond yields tend to follow commodity prices downward. As prices decrease, the volume of capital required in industry is lessened and the demand for capital thus falls off, lowering its price.

A chart showing the yield on a number of corporation bonds is found in a study of prices made by ex-Senator Theodore E. Burton and G. C. Seldon. They have shown that the average yield on a large number of corporation bonds in the United States has varied either upward or downward with the level of commodity prices in this country. In 1860 the average yield was found to be between 6½ and 7½ per cent. During the Civil War the yield declined somewhat, but towards its close it had again risen, and averaged between 6 and 7 per cent. After the close of the Civil War, bond prices gradually rose until about 1873 when the average price was found to be between 7¾ to 8¼ per cent. In this same period, commodity prices as prepared for the Aldrich Report, rose from 100 in 1860 to 132 in 1866. Greenback prices in this period rose from 100 to about 230. Beginning with 1865, they gradually declined. Gold prices and greenback prices both reached the same level after specie payments were resumed in 1879. Following this date, commodity prices increased somewhat up to 1883, and from that time on they steadily declined until the low point was reached in 1897, the index number at this date being about 74. From 1897, commodity prices rose steadily until 1915, by which date they had reached about 130. During the World War they rose very rapidly and by the close of the war, had risen above 230.

The yield on bond prices followed the curve of commodity prices rather closely. From an average yield of between 7¼ and 8¼ per cent in 1873, they dropped to an average yield of from 4¼ to 4½ per cent in 1890, rising somewhat between 1890 and 1895, but after 1895 they declined to their lowest point for the period in the year of 1900, showing at that time an average yield of about 3¾ per cent. Since 1900 they gradually rose and by the beginning of the World War, the average yield on corporation bonds was between 4¾ and 5 per cent. By the close of the war, the yield had risen to between 5¼ and 5¾ per cent. Since the close of the war, the average yield has risen even more rapidly and at present averages about 7.05 per cent.

### Cost of Money at the Present Time to Public Utility Corporations

In endeavoring to determine the cost of money at the present time to public utility corporations, there are several important factors that must be taken into consideration. The cost of money incident to the acquisition of the first money needed by a new corporation, would be different from the cost to obtain money for enlargements or improvements in a going concern. This is due to the fact that only a part of the total capital

needs of a corporation can be secured by a first lien on the property. In other words, all of the securities issued by a corporation cannot be equally secured as regards assets. Usually not above 60 per cent of the total bonded indebtedness of any corporation can be secured by assets termed the highest class. The remaining 40 per cent of the company's capital needs must thus be raised through the sale of junior issues. No corporation can hope to raise its entire capital needs by a single issue secured by a first mortgage on its entire property value. Since a large part of capital needs must be raised through junior issues, they can be sold only if the yield is considerably higher than that offered by a senior issue.

In the case of a going concern, seeking additional capital, it is practically impossible to offer the new securities in any volume on a parity with the senior issues of the company, even though the company is thoroughly sound and conservatively managed. Even aside from the nature of the security, new issues are always at a disadvantage in relation to the more seasoned issues which have been fairly digested by the investing public. The result is that new securities offered for the purpose of additions and betterments, must usually not only of additions and betterments, must usually not only of the company, but, in order to attract new capital, must offer even a higher yield.

### Credit of Public Utilities in Disrepute

The credit of public utility corporations on the whole, is at present more or less in disrepute so far as the general investor is concerned. This is not a matter of theory or opinion, but one of fact. A glance at the price at which the highest grade public utility securities in the United States are selling, at the present time, proves this beyond doubt. The highest grade American public utility securities can be purchased in the open market on a basis that will yield the investor anywhere from one to two per cent per annum more than the same sum would yield were it invested in any other similar grade of corporation securities. According to the bond yield computed on five average United States Public Utility Bonds by "Brookmire's Economic Service," this type of security on May 1 could have been bought on a basis to yield more than 2 per cent in excess of the yield afforded by a similar investment in other railroad bonds or manufacturing companies. According to Brookmire's figures, the average yield on 5 public utility bonds considered as representative issues, was 8.60 per cent on this date. On the same date, the yield on 6 bonds, representative railroad bonds, was 6.14 per cent. The following table, taken from Brookmire's Financial Bulletin of May 3, shows the following changes in bond yields since before the war:

| Bond Yields | Now | Mo. Ago | Jan. 1916 | July 1915 | B'f're War |
|---|---|---|---|---|---|
| U. S. Aver. 5 Pub. Utility. | 8.60 | 8.19 | 5.18 | 5.31 | 5.09 |
| " " 5 Railroad . . . | 6.14 | 5.86 | 4.51 | 4.71 | 4.42 |
| " " 5 Manufac'g. . | 6.41 | 5.92 | 4.89 | 4.99 | 4.93 |

Feeling that deductions as to the average yield afforded by public utility investments as indicated on the basis of only 5 companies was not likely to give a fair average, a compilation was made covering 17 highest grade American public utility issues. Only issues rated by Moody in his "Analysis of Public Utilities" as A, AA on AAA were used. A compilation was made showing the yield to the investor, should any of these securities have been bought at their market price during the period from April, 1919, to May 1, 1920. On the basis of this compilation, the following results were obtained: The average yield on the 17 highest grade public utility securities, between April, 1919, and December, 1919, was found to be 6.11 per cent. The average yield from January, 1920, to May 1, 1920, was found to be 6.75 per cent.

A similar compilation was made for 3 of the highest grade bond issues of the Atchison, Topeka & Santa Fe Railroad and two highest grade issues of the Union Pacific. The average yield on these highest grade railroad bonds from April, 1919, through December, 1919, was found to be 5.52 per cent. The average yield from January, 1920, to May 1, 1920, was found to be 5.75 per cent, thus showing that even the highest grade first mortgage public utility securities have recently been selling at a price which would yield the investor a full per cent more income per annum than could be obtained from the same class of railroad securities. A further tabulation covering the average yield on 9 second class public utility securities, that is, bonds rated by Moody as B. BA, BAA during this same period, showed that they sold at a price which would have yielded the investor, had they been bought between April, 1919, and December, 1919, 6.58 per cent. Had they been purchased at the average market price between January, 1920, and May, 1920, they would have yielded 7.20 per cent, the yield on this class of securities being almost a full point above that afforded by the highest public utility security.

Since the seasoned bonds of our largest public utility corporations rated by reliable investment houses as bonds having the highest grade of security can be bought on a yield basis of 6.75 per cent and those of the second class on a yield basis of 7.20 per cent, it would scarcely be expected that new securities of public utility companies could be sold on even as favorable a yield basis as that afforded by a seasoned second grade bond. Experience shows that new securities of the highest grade cannot be sold for the same price that a similarly secured bond can command, that has been seasoned. Thus, a company endeavoring to raise money through the issuance of new securities, is handicapped at the very start by the fact that the securities it is offering are new and unseasoned. In addition to this, the new securities of a going concern seldom rank as high in regard to the security behind them, as do the seasoned issues secured by a first mortgage on the property. New issues usually compete with the yield afforded by second grade or junior issues, and even in competition with such issues, new securities are at a disadvantage. The extent of the disadvantage in this regard is convincingly shown by a comparison of the yield basis on which new securities of public utility corporations have been offered at, between January 1, 1919, and May 15, 1920. A study of the yield afforded by the principal representative offerings of public utility securities to the public, of $1,000,000 or over, in the period above mentioned, was found to be as follows:

COST OF MONEY TO PUBLIC UTILITY CORPORATIONS, EXCLUDING MARKETING PROFIT TO UNDERWRITERS

| Date | Yield |
|---|---|
| January 1, 1919 to July 1, 1919 | 6.86 per cent |
| July 1, 1919 to December 1, 1919 | 6.90 per cent |
| January, 1920 | 7.10 per cent |
| March, 1920 | 7.59 per cent |
| February, 1920 | 7.11 per cent |
| April, 1920 | 7.62 per cent |
| May, 1920 | 7.83 per cent |

The above figures were compiled from a list of bond underwriters issued by the Standard Statistics Company in its weekly service and from the Commercial and Financial Chronicle.

Since the signing of the Armistice, interest rates the world over have been gradually rising at an accelerating rate. The weekly statistics issued by Brookmire's Economic Service in their pamphlet entitled "Brookmire's Forecaster," dated May 17, 1920, throws some interesting sidelights on current interest rates and the changes that have taken place within the last few years. Sixty-day money, N. Y. Stock Exchange, in May, 1913, was 3½ to 4 per cent. Two years ago it was 6 per cent. For the week ending May 15, of this year, it was quoted at from 8 to 8½ per cent. Discounts prime 4 to 6 months, New York, were 5¾ to 5½ per cent in May, 1913; 5¾ to 6 per cent two years ago; 7 per cent May 15. How rapid the increase has been since January of this year, is shown by statistics taken from the same source. Four to six months prime discounts, New York, were 6 per cent in January and 7 per cent in May of this year. Sixty-day money, N. Y. Stock Exchange, was 7 to 7½ per cent in May. This tightening of the money market is reflected in every class of security in the world—U. S. Government bonds have been selling at a price to yield the investor in many cases, in excess of 6½ per cent. This situation is not due to any question or doubt as regards the security involved, but is primarily indicative of the tremendous demand for capital funds. The war depleted the supply of funds to such an extent that at present the supply of funds available for investment in permanent improvements is totally inadequate.

How seriously this situation is handicapping new improvements of public utility corporations is well illustrated by the following quotation from the *Wall Street Journal:*

"CHICAGO TELEPHONE COMPANY WITHDRAWS $10,000,000 NOTE APPLICATION

"The *Wall Street Journal,* April 12, 1920, stated that President Sunny has informed Illinois Public Utility Commission that Lee, Higginson & Co., and five leading Chicago bankers jointly bid 94½ per cent for the company's proposed issue of $10,000,000 three-year 7 per cent notes, or yield basis of 8.99 per cent, which is a prohibitive price for public utility credit and, therefore, the company has withdrawn its application to issue these notes for needed improvements this year. The company placed a similar amount of notes with the syndicate a few years ago slightly above a 5 per cent basis."

When the cost of money to a public utility property is specifically considered at the present time, it must be realized that the cost of money to industry in general does not necessarily determine its cost to a public utility corporation. Capital does not flow as freely in actual practice as it might theoretically be supposed; it is flexible only within narrow limits. The total capital fund available for investment at any time is not in active competition for all types of investment. Capital is controlled by various individuals and moves only in accordance with their preference and prejudice. These preferences and prejudices are the determining factors controlling the flow of capital into the various fields of investment. Psychological forces play a very prominent part in the cost of money to industry. Very often the actual security behind a given investment proves to be of less importance than is the popular opinion regarding the security held by a large group of investors. In other words, the attitude of the investing public towards a given type of investment often becomes the dominant factor controlling the price of money in that field. Of the total fund of capital available for investment in the United States to-day, there is only a given amount available under any circumstance for railroads, public utilities, industrials, farm loans, real estate loans, certificates of deposit, savings bank accounts, stocks or government bonds.

It is an established fact that there are thousands of individuals having considerable investment capital at their disposal who would under no circumstances purchase a corporation security, even a very high yield would not attract them. An illustration of this is found in the ability up to just a few months ago of the Federal Land Bank to float its farm loan bonds on a yield basis of 4½ per cent at a time when tax free government bonds were being offered on a yield basis of close to 6 per cent. Investigation has shown that in a large measure these bonds were purchased in small lots by farmers and residents of small towns, individuals whose income is so small that the tax free covenant in these bonds would have no particularly attractive force. There are likewise thousands of individuals in the United States who have a strong preference for 6 per cent real estate loans—still others have a strong preference for municipal securities. The result is that there are millions of dollars of available investment funds in the United States that would under no circumstances compete in the market for corporation bonds.

There are several reasons determining this attitude of mind in regard to investments on the part of thousands of people in the United States. Regardless of the causes producing this attitude of mind, the important factors to be considered under the present circumstances are the existing facts. It is quite obvious, from the abnormally high price that public utility corporations have been compelled to pay for capital recently, that investments of this type are rather generally considered as less desirable than many classes of investments. There are two factors that seem to have been dominant in producing this situation.

First, public utilities because of their special and privileged position in the past took in some cases undue advantage of this position. The result was that thousands of small investors lost heavily in investments of this type. In other cases some few public utilities abused their semi-monopolistic position and charged an excessive price for their services. Public opinion finally revolted and there was enacted various restrictive legislation which so limited the control of public utilities over the selling price of their services as to place them entirely at the mercy of various rate making bodies.

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## As the Journal Views It

### What Do We Offer?

Through a concerted effort unknown in the past we are bringing the gas industry quite prominently before the minds of the American people.

What is our ultimate aim? Will we have accomplished what we have gone after when we have attained: Restriction of coal export; compulsory consideration of our needs on the part of the oil industry; higher rates?

All these things, though necessary, to keep the works running, are essentially selfish on our part.

Restrictions on coal export cannot but have a reaction in denying to the coal operator a portion of the profit he otherwise might have. When we restrict his exportations we in effect compel him to sell at home at a lower price the product he might sell abroad at a higher. If we stood ready and able to pay for coal what the foreigner will pay there would be no need of export restrictions.

Compulsory consideration of our needs by the oil companies is in part compelling them to sell to an undesirable customer at a time when highly desirable customers are clamoring for service; in such manner placing a denial upon them that gas companies may benefit.

The oil companies to-day need none of our business; want none of it. There was a time when to them the gas company was a port of salvation, a pearl beyond price. To-day the gas company is an old-time acquaintance that would gladly be forgotten. There are other customers standing waiting who do not quibble at costs and who apparently can produce real money.

Higher rates involve a sacrifice and denial upon the part of the consumer.

Yet all these demands on our part are justified by the need. But surely as we make them we should offer something in return.

And what do we offer?

A service that we declare has become an essential to human existence.

This is true, but with qualifications.

Before gas people cooked and lived. They burned wood and coal and other things.

And there are still numerous communities in which such primitive methods are still practical.

In congested centers they are not.

Here electricity could be substituted. It is true that this would involve a great economic waste. But this objection is merely comparative. Economic waste is involved also in gas supply as it is viewed to-day.

So on the mere basis of supplying an essential service we are not so greatly entitled to public consideration as we would like to feel that we are.

Asking as we do that the American people deny themselves that we may continue to live it is but right that we should offer a justification for our continued existence that is bigger and broader and more constructive than this.

And that justification is ready at hand should we be willing to accept the responsibility and obligations that pleading it and publicly identifying ourselves with it will involve.

In the gas industry the public has an agency at hand that may prolong the life of the nation's cheap oil resources through salvaging from coal motor spirits that now are wasted; that may rescue from the smoke-pall fertilizers, colors, fuel—that, in short may get out of the nation's store of coal infinitely more than is now being gotten out of it, and that so doing will keep smoke out of its skies, ash cans and ash carts off its streets, release to more productive enterprise thousands of human workers and ton-miles of transportation facilities.

An industry that may be counted upon to accomplish such things is obviously so essential economically to the nation that no matter what cost its continued existence must be insured.

## Of Course

News items are interesting.

One in this issue recites how a gas company has come before a regulatory board for permission to issue new stock to meet floating indebtedness and new construction.

It offers an eight per cent return and the stock is to be issued to present stockholders at par.

As things go nowadays this isn't much of a return on the investment. The writer of this comment isn't one of those sagacious financiers himself, but he's getting ten per cent on the same money he used to be glad to have securely invested at five. However, he is not particularly gratified with the situation. He used to be able to buy a couple of pair of shoes and a straw hat with the proceeds of the five per cent investment. With the proceeds of the ten per cent securities he can buy the shoes, but he is wearing last summer's hat.

One is impressed with the loyalty of the gas company's stockholders. That they are satisfied with an eight per cent return on a preferred stock sold at par, speaks very well for their willingness to help shoulder the burdens of especially trying times.

They really could get a much better return on their money were they to invest it elsewhere.

This gas company seems very fortunately situated indeed. It is getting an unusually good deal.

The city solicitor of the municipality affected was at the hearing. One gathers from the news report that he was not particularly informed as to what it was all about. Nevertheless he had no hesitancy in announcing that if the transaction meant an increase to consumers the city would oppose it. Of course!

City officials are confirmed protesters in anything gas companies do to hobble through a situation that threatens their very existence. Right or wrong, they seem to consider the one best rule as applied to gas companies is to make impossible any means by which the stubborn mules may adopt to insure to their community the continuation of a highly necessary service.

## Why Not Before?

At Sturgis, Mich., citizens have voted 761 to 174—overwhelmingly it might be said—for a gas rate increase of sixty-five cents a thousand.

But meantime the gas plant had been shut down. Sturgis apparently believed the gas company was merely shouting "Wolf." After the gas was off Sturgis took the trouble to investigate.

The increase was granted principally on the recommendation of a citizens' committee, which investigated the company's books.

Evidently it was amply justified; would have been probably before the company had to shut down. But Sturgis was too indifferent to find out. It paid for its indifference by its three weeks without gas service. But this did not compensate the company for a loss of revenue it was justly entitled to. Both suffered.

When a gas company says it is losing money it is either telling a lie or the truth. The average American municipality has ready means at hand for determining which. Calamities such as occurred at Sturgis could be avoided. It is a reflection on a community's intelligence and civic energy not to avoid them.

## Gas as an Aid in Manufacture of Solders

(*Continued from page* 104.)

nickel 9.5 and (2) Copper 28, zinc 50, nickel 12. No. 1 requires a very hot flame for melting, although an atmospheric burner will suffice, but No. 2 can usually be melted only by a blast brazing burner.

### Silver Solders

The solders which contain silver are very strong and tenacious and are used not only to solder silver but also for other metals, in cases where the objects to be soldered require great power of resistance. Two principal kinds of solder are usually recognized—hard and soft. The former consists of silver and copper with sometimes a little zinc; and the latter contains besides the metals first mentioned, a small amount of tin.

Hard silver solder has different compositions varying in fusibility according to the purpose for which it is intended. Silver workers, in fact, use different solder for alloys of varying degrees of fineness, and the same ones are not always employed for resoldering as for the first soldering.

Very hard solders for fine silver articles are made of 1 part of copper to 4 of silver.

Hard solder is made either (No. 1) of copper 1 part, silver 20 and brass 9 parts, or (No. 2) copper 2, silver 28 and brass 10 parts.

Soft silver is: (1) Silver 2 and brass 1 part; (2) Silver 3, copper 2 and zinc 1 part; (3) Silver 10, brass 10 and tin 1 part; (4) These solders serve principally for completing the soldering of silver articles done with hard silver by retouching imperfect places. Some silver workers use for this purpose copper and silver alloys mixed with zinc, as for example the following: Copper 4, silver 12 and zinc 1; (5) Silver 5, brass 6, zinc 2. The latter is readily fusible, but also rather brittle and is frequently used for soldering ordinary silverware.

Solders for iron, steel, cast iron and copper are: (1) Silver 10, brass 10; (2) Silver 20, copper 30, zinc 10; (3) Silver 30, copper 10 and tin 0.5.

Soft silver consists of silver 60, brass 60 and zinc 5 parts.

In the case of solders which are prepared with brass, care has to be taken that neither of the metals in the composition contains any iron, as it has been found by experience that the presence of a very trifling amount of this element is sufficient to change the character of the alloy materially, making it brittle.

Silver solders are used in the form of the filings or wire, the latter method of preparing it being especially adapted to the tenacious and ductile nature of the alloy.

In the larger silverware factories it has been the custom for some time past to use the same alloy for soldering as that of which the silver article is made. It is used in the form of filings and melted into the seams so that the object and the solder are actually homogeneous.

### Gold Solders

Gold, when pure and variously alloyed, is used to a considerable extent in soldering, but on account of its expensiveness it is limited to articles made of gold or platinum, or the most delicate small steel objects.

Gold alloys are of different colors, according to the kind and proportions of the other metals used. These are yellow, red, white and green gold alloys. The color of the special alloy should, of course, be in harmony with the color of the object to be soldered, in order that the seams may be as inconspicuous as possible, the fusibility of gold alloys varies as much as their color and is lowered as the amount of gold in the alloy increases. Harder solders should, therefore, be used for objects of fine gold than for a poorer quality. Gold solders are made from gold and silver, gold and copper, and still more frequently from a mixture of all three of these metals. In some cases zinc is added to make the solder softer, but this must not be done if the soldered articles are to be colored as the zinc alloy will turn black in coloring. For objects which are to be wholly or partially enameled the solders made of gold and silver, or gold, silver and copper are the only ones used and these are called "enamel solders."

### Pure Gold Solder

Before soldering apparatus had been devised by means of which platinum could be melted, pure gold was used for soldering articles made of this metal, such as are employed by chemists and in the manufacture of sulphuric acid. For this purpose the gold is laid upon the seams in the form of fine rolled wire or in thin strips and melted with oxyhydrogen blowpipe or else some other suitable flame, but experience has shown that platinum articles soldered with gold are far less durable than those made by direct melting together of the pieces of platinum with the blowpipe or soldering burner, especially in the case of the vessel used in distilling the English sulphur acid. Of late years this process has become immersed in the manufacture of platinumware and the gold is only used for repairing small platinum articles, such as the small crucibles and dishes for chemical laboratories. It requires a fierce white heat to melt it properly, and it is even then rather hard, so that the process demands great skill on the part of the workman.

Hard gold solder consists of gold 750-1000 fine (18 karat), 9 parts; silver 2 parts and copper 1 part.

Soft gold solder has gold 750-1000 fine (18 karat) 12 parts; silver 2 parts and copper 1 part.

This is likewise used for fine gold but is much more fusible than the one first given.

Gold solder for articles of 14 karats (i. e., 583-1000 fine), is made of (1) gold 583-1000, 3 parts; silver 2 and copper 1 part. (2) Also gold 583-1000 fine (14 karat, 4 parts; silver 1 and copper 1.

Gold solder for ordinary goldware less than 14 karat is made of (1) fine gold 1, silver 2 and copper 1 part. Also (2) fine gold 1 and copper or silver 1. Soft gold solder is either made of (1) fine gold 11.94, silver 54.74, copper 28.17 and zinc 5.01 or (2) gold 14 karat (583-1000 fine), 10 parts; silver 5 parts and zinc 1 part.

Hard enamel solder consists of gold (18 karat) 37 parts and silver 9 parts. Soft enamel solder is made with 16 parts of 18 karat gold; 3 of silver and 1 of copper.

The degree of fusibility of the enamel must decide the question as to which one of these compositions to use. If it is very hard, the first solder is the proper one, as otherwise the seams would become so hot during the process of melting the enamel that the solder itself would melt. In ordinary goldware soft enamels are

generally used and in this case the softer solder can be employed. It is easily melted with the usual soldering gas torch or pipe as the jeweler calls them; the harder can also be melted in the same way, but there is a different blast burner which is used for this work to somewhat greater advantage.

The way the jeweler removes tarnish from gold after hard soldering is as follows: The gold is painted over before soldering with a mixture of yellow ochre, ground up with water and a small quantity of borax. After soldering it is thrown into a pickling solution consisting of water 9 parts and sulphuric acid 1½ parts. If the gold is whitish looking and shows the silver alloy after being removed from the pickle it is dipped for a moment in a hot solution of sulphuric acid and saltpeter. It is then washed, first with "rotten stone" and oil; then after washing it is again polished with rouge.

## Aluminum Solders

Since the discovery of aluminum and its production in considerable quantities it has become a most common material. One of the greatest difficulties, however, has been in the past, that there was no perfect solder for aluminum and various alloys were used which gave unsatisfactory results. This difficulty has, however, been overcome and it is possible to solder the metals so perfectly that in tests which have been made the metal itself broke before the solder gave way. The French manufacturers use five kinds of solders for aluminum all consisting of zinc, copper and aluminum in different proportions, these are given below:

| | Parts by Weight | | |
|---|---|---|---|
| No. | Zinc | Copper | Aluminum |
| 1 | 80 | 8 | 12 |
| 2 | 85 | 6 | 9 |
| 3 | 88 | 5 | 7 |
| 4 | 90 | 4 | 6 |
| 5 | 94 | 2 | 4 |

There are also other compositions besides these. Bourbouze recommends for objects which are to be further manipulated or worked on after soldering, a mixture of 45 parts of tin and 10 parts of aluminum.

Irischrisuth gives the following alloys for solders: (a) Silver 10, copper 10, aluminum 20, tin 60, zinc 30; (b) Tin 95 to 99 and bismuth 5 to 8. The composition (b), which is an ordinary soft solder, is adapted for soldering aluminum by means of the common soldering iron. In preparing aluminum solders the alloy of copper and aluminum is always made first and the zinc added. First of all the copper is melted and this can readily be done in a gas fired crucible furnace. Then the aluminum is put in gradually—usually 3 or 4 portions. The two metals are of very difficult densities and the mixture has to be stirred with a rod to unite them as far as possible. Immediately after adding the last portion of the aluminum, the zinc is put in and at the same time fat or rosin is thrown into the crucible—the whole is stirred, the crucible is removed from the furnace and the alloy is poured into molds which have been rubbed with coal oil or benzene. The whole work must be done as quickly as possible (and this makes gas most desirable due to the speed obtainable with it) after the addition of the zinc or the solder will not remain in a suitable condition.

The zinc used should contain no iron as a very small amount of the latter would materially affect the fusibility and durability of the solder.

The purpose of the fat or rosin is to be prevent the oxidation of the zinc, and as before noted the work must proceed as rapidly as possible from this moment as the temperature of the mass is so high that if it were left long in fusion much of the zinc would be volatilized. On account of its resistance to chemical influences, aluminum solder is frequently used by dentists to unite the metallic parts of artificial teeth, but alloys for this purpose must not contain copper except in very small quantities as this metal is easily attacked by acids.

Platinum and aluminum solder is made from gold 30 parts, platinum 1, silver 20 and aluminum 100 parts. Aluminum and gold solder contains 50 parts of gold, 10 of silver and 10 of copper and 20 of platinum.

There is a solder for aluminum bronze which is of interest. First of all, let it be said that aluminum and copper make a very beautiful alloy and one of valuable properties. Aluminum bronze demands a special composition and for this purpose a common soft white solder is generally used, mixed with zinc amalgam in different proportions—either 2, 4 or 8 parts of the solder to 1 of the amalgam. Zinc amalgam is an alloy of zinc and mercury which is evident from the name amalgam being used. To prepare it 2 parts of zinc and 1 of mercury are united by the aid of heating them together. The zinc is melted and the mercury is quickly stirred in. The mixture is then quickly cooled. It makes an alloy silver-white in color and somewhat brittle. To make the solder for aluminum bronze the soft solder is melted, the zinc amalgam, finely powdered, is added and the mass is at once poured out into molds.

The soldering has to be done with an "iron" made of pure aluminum. If other metals were used it would alloy itself with them and its composition would be changed.

In using the five aluminum solders which have been given above, the kind of soldering to be done must be taken into consideration. In small ornamental objects, for instance, No. 1 may be used; for larger articles, such as teapots, coffee-pots, etc., No. 1 is most frequently employed.

Originally the solders composed of aluminum and zinc were the only ones used for aluminum articles. Large objects were first put together with an easily fusible solder and the soldering finished with a harder one. The alloys of aluminum and zinc have the disadvantage that they oxidize easily in melting and the work is made much more difficult thereby. This can be remedied by dipping the fine grains of the solder, in which form it is used in "Copaiva balsam," which acts as a reducing agent besides excluding the air; but this is not necessary if the composition containing copper is employed.

## Methods of Soldering Aluminum

There is no solder which operates with aluminum in the same way that ordinary solders operate with copper, tin, etc. There are two reasons for this. First of all, aluminum does not alloy readily with solders at temperatures as low as the other metals require and it is consequently necessary in soldering aluminum to use a much higher temperature. Furthermore, aluminum alloys with lead only with great difficulty and with but a small proportion of lead at that; consequently, lead solders are useless with aluminum. Secondly, the surface

of all aluminum is covered with a thin invisible coating of aluminum oxide. This coating forms instantly on the surface of aluminum and is very refractory, and its presence is responsible for the high resistance of aluminum to corroding agents, although aluminum itself is soluble in a great many chemical compounds. This protective coating of oxide is insoluble in almost everything excepting hydrofluoric acid; while in general this coating of oxide is beneficial in that it forms a perfect protection to the aluminum underneath. It is by reason of its efficiency in this particular, responsible for the principal portion of the difficulty which occurs in soldering aluminum as naturally no solder will alloy with aluminum oxide.

In soldering aluminum, therefore, it is necessary that this oxide be removed before the soldering can take place, and as it forms again instantly after removal, it is necessary that the removal of the oxide and the covering with solder shall be simultaneous. In soldering other metals the oxide can be removed chemically. With aluminum this is not possible and it must be removed mechanically by abrasion. Bearing these facts in mind it will be readily understood how aluminum soldering must be done. All the surface to which it is intended that the solder shall adhere must first be tinned.

This is accomplished by heating the metal to a temperature above the fusion point of the solder used and then rubbing the surface with a stick of the solder, thus rubbing the oxide off the surface with the solder itself and covering the exposed points with melted solder, all in the same motion. In order to make sure that the tinning is thorough it is better to rub the surface with a steel or brass scratch-brush while the solder on the surface is still molten. This insures a thorough bit of tinning. After the edges to be united are thus tinned they may be sweated together with fine block tin with the aid either of a soldering iron or blast burner—a standard brazing burner is most satisfactory, using gas and air under pressure. With regard to the composition of aluminum solders, zinc appears to alloy with aluminum more readily than any other metal available for the constituent part of the solder, consequently all solders which will readily "tin" aluminum contain zinc in varying proportions.

The solders which have been found to be most satisfactory are composed, as stated previously, usually of tin, zinc and a very small proportion of aluminum. These solders do not run very freely nor fuse as readily as ordinary solders to use a higher temperature. Too high, in fact, that extreme difficulty will be found in using these solders with a regular soldering iron, as it is generally necessary to use a blast burner right at the work.

Another thing which must be borne in mind is, that solder will not flow into an aluminum joint even when tinned by capillary action as it does into copper or tin joints. Therefore it is necessary to place on the surface to be united all of the material necessary to sweat them together before the edges are brought into contact. In soldering aluminum joints, it is necessary that both the tinning and sweating shall be most thoroughly done, otherwise the joint will not be durable.

On account of the presence of zinc in the tinning and solders the solders are decomposed by moisture, and unless the work is so well done that the joint is absolutely waterproof, it will not be durable. The quality of the workmanship has more influence than anything else on the permanence of the work.

In a later article the writer hopes to include details regarding solders for special purposes, cements and other similar materials into manufacture of which gas enters.

## Dyes from Gas Works

In the manufacture of ordinary illuminating gas a considerable amount of prussic or hydrocyanic acid is formed—about 1½ lb. for every ton of coal distilled. This has to be removed, and it has been found that the gas industry can meet the demand for prussiates. In future developments, however, there is the possibility of obtaining cheap cyanogen compounds by fixation of atmospheric nitrogen.

There are two principal methods for obtaining prussiates from coal gas. The earlier one is known as a dry process; the more recent is wet. In the dry process the gas is passed over layers of iron oxide; the sludge obtained from an aniline plant, when mixed with sawdust and exposed several days to the air, is quite suitable. The impurities in the gas—ammonia, prussic acid and sulphureted hydrogen—are absorbed to form sulphides and Prussian blue. When the oxide is "choked" it is put in the air to oxidize, and can then be used again. After many such treatments the iron oxide becomes useless for further purification and is thrown out as spent oxide. It may contain anything from 3 to 16 per cent of Prussian blue and some sulphocyanides. These oxides, containing over 7 per cent Prussian blue, can be successfully treated to obtain prussiates at an economic price.

The spent oxide is first washed, whereby the ammonia and soluble sulphocyanides are removed. The residue is treated with milk of lime in order to decompose the Prussian blue into soluble iron oxide and soluble calcium ferrocyanide. After filtration (the recovered iron oxide can be again used in the gas purifiers), the liquor is treated with sodium or potassium carbonate, whereby calcium carbonate is thrown down. The clear liquor is concentrated in order that the alkaline ferrocyanide may crystallize out.

An improved method is to add potassium chloride to the calcium ferrocyanide liquors. By this means a sparingly soluble double salt of potassium calcium ferrocyanide [$K_2CaFe(CN)_6$] is precipitated. This substance is filtered off and treated with sodium carbonate as before.

Another alternative is to wash out only a portion of the ammonia from the spent oxide. Then the lime treatment produces an insoluble ammonium calcium ferrocyanide [$(NH_4)_2CaFe(CN)_6$]. This crystallizes out in the cold and is filtered off and worked up as for calcium ferrocyanide.

The above modifications are devised in order to avoid the troublesome filtration of Prussian blue.

In the wet process the gas is purified by passing it through a liquid. The crude gas is passed, either directly or after first extracting the ammonia, through an alkaline suspension of a mixture of ferrous hydroxide and carbonate. The net result of a complicated reaction is that Prussian blue is formed. When the amount accumulated is sufficiently large, it is filtered off and treated with lime, etc., just as in the treatment of the spent oxide. From the ammonia liquors can be obtained ammonium sulphocyanide. But for a larger production the crude gas is passed into an aqueous sulphur suspension, whereby the ammonia and the prussic acid react to form ammonium sulphocyanide.

## Oil Shales and Their Economic Importance*

By Martin J. Gavin
(Refinery Engineer U. S. Bureau of Mines)

The twentieth century has often been spoken of as the age of petroleum, and from many viewpoints it can be justly considered so. Certainly the petroleum industry is one of enormous importance to this country, industrially, financially, and economically. The United States, however, at present producing over 60 per cent of the world's total output of petroleum, is not producing petroleum at a sufficient rate to provide for its own domestic consumption. For several years this country has been importing increasing quantities of crude and partly refined oils from Mexico, and has been drawing heavily on domestic stocks of petroleum. Production in the United States is increasing, but it is not increasing at the same average rate as domestic consumption, nor is it probable that in the future domestic production will increase sufficiently to satisfy the demands of domestic consumption, but on the contrary, in the opinion of those best qualified to know, the peak in the curve of domestic production of crude petroleum will be reached in a comparatively few years, whereas the consumption of petroleum and its products will increase at a continually growing rate. This country, then, must turn and, as the increasing imports from Mexico indicate, is turning to other sources than the crude petroleum produced in this country to make up the deficit between domestic production and domestic consumption of petroleum and its products.

The chief products of petroleum are motor fuels, kerosene, fuel oils, and lubricating oils. Of these, the increasing demand for motor fuels or gasoline is perhaps the greatest, and that of fuel oils probably next greatest. The ever-growing use of the internal combustion motor, especially in automobiles and trucks accounts for the first, and the increasing use of fuel oil, chiefly for steam-raising purposes, accounts largely for the second. Lubricating oils are, of course, of prime importance, as machinery must be lubricated if it is to operate.

To help make up the deficit in our supply of petroleum we can expect to draw on the enormous potential petroleum supplies of Mexico at an increasing rate, and by the use of new and improved processes of manufacture a greater percentage of the petroleum products for which there is the greatest demand will undoubtedly be obtained from petroleum. The more efficient utilization of these products, as for example, through the development and use of the Diesel engine and the gradual change in the design of our present internal-combustion motors, enabling them to use lower grade fuels, will perhaps tend to relieve the growing shortage. Hydroelectric power or electricity otherwise produced, can be expected to take the place, to a certain extent at least, of fuel-oil installations on land. However, all these expedients have their practical limitations, and it is to be expected, therefore, that in the comparatively near future new resources of products similar to those now being derived from oil-well petroleum will have to be developed. As a matter of fact, some are already being developed.

There are possibilities of importance in the development of the production and use of benzol as a motor fuel and other coal-tar products as Diesel engine fuels and as substitutes for other petroleum products. There are also important possibilities in the commercial production of alcohol as a motor fuel. In fact, blends of alcohol, benzol, and petroleum distillates are being marketed in the East at the present time as motor fuels and are giving satisfaction in use. Taking all these considerations into account, however, it is the opinion of many that the oil shales of Utah, Colorado, Wyoming, and Nevada, and possibly other States, are extremely important as new sources of products similar to those now obtained from oil-well petroleum. These States contain enormous deposits of oil shales which by proper treatment yield gas, oil, and also, if desired, ammonia, of value as a fertilizer. The oil in many respects is similar to oil-well petroleum and yields products similar to those of petroleum.

Oil shales have been worked in Scotland and France for upwards of sixty years. In the former country the industry has been a successful one from a financial standpoint, especially of late years, although it is passing through a difficult period at present. The industry in France has not been nearly so successful as that in Scotland. The success of the Scotch shale industry has been partly brought about by the development of cheap processes for treating the shales and the oils produced from them, but mostly by local conditions, such as competition only with high-priced petroleum products, low labor costs, and the fact that the industry grew up in a densely populated region where a ready market for oil and ammonium products was available. A recent reorganization of the Scotch shale companies, combining them into one organization, is hoped to better the present condition of the industry in Scotland.

Oil shale contains little or no oil as such, but it contains substances which when the shale is subjected to destructive distillation yield gas, crude oil, and nitrogen-containing compounds, notably ammonia, as well as other products in small and probably of unimportant value for the most part. Oil shale as a rule must be mined much as coal is mined, crushed, and heated to a relatively high temperature in closed retorts which may operate continuously or intermittently. These steps are necessary to produce the gas, crude oil, and ammonia, the latter of which is in solution in the water obtained along with the oil.

The ammonia water is then distilled and the released ammonia passed into sulphuric acid, producing ammonium sulphate. The crude oil must be refined, much as petroleum is refined, to produce the various commercial products. The refining of shale oil is more complex and in all probability more costly than the equivalent refining of petroleum. However, undoubtedly the shale oils can be refined and can be made to yield many products similar to those produced when peroleum is refined. The oils produced from the oil shales of this country will yield gasoline, burning oils, and paraffin wax, all of which when properly treated will undoubtedly be satisfactory commercial products. Whether the more viscous grades of lubricating oils, such as lubricants for internal-combustion motors, can be produced from shale oils is doubtful, but it may be possible to do so. Little is known in this country as to the refining of shale oils at the present time, and this statement can be applied generally to the possibilities and technique of oil-shale operations in the United States.

* Presented by permission of the Director, U. S. Bureau of Mines, before the 13th Convention of the Utah Academy of Sciency, April 3, 1920.

The development of an oil-shale industry to one of considerable importance in this country, will require the expenditures of many millions of dollars and take a period of many years. Such development will require much research and technical study, and will require the services of trained executives and experienced technicians. Nevertheless, when economic conditions become favorable it is reasonable to believe that our oil shales will be of great value as a source of oils similar to those now derived from petroleum. An idea of what large-scale development of the oil-shale industry involves, may be gained from the consideration that to produce one barrel of crude oil from shale, on the average at least one ton of a tough rock must be mined, crushed, heated to a relatively high temperature, and finally the residue, amounting to about 75 per cent of the original weight of the raw shale, must be disposed of as valueless. The United States now produces over one million barrels of crude petroleum per day.

Our immense oil-shale deposits practically assure us that come what may, this country will still have its own sources of petroleum products. We should never have to be wholly dependent on foreign countries in this respect. From another standpoint the shales are also of great economic importance. The oil shales, especially of the Rocky Mountain country, occur in sparcely settled regions. Their development on a large scale means the bringing into these regions of a great number of miners and other laborers, often with their families, who will earn their living in the shale fields and spend their money in the same locality. Millions of dollars must be spent in erecting plants, developing mines and the like, much of which will be spent in the States where the oil shales occur. The shale-oil refineries will require sulphuric acid and other chemicals and supplies, which logically will be produced as near to the shale fields as possible, thus bringing in more capital and labor. Transportation facilities will be extended to meet the requirements of the shale operators, thus benefiting the regions now inadequately supplied in this regard. Prices of petroleum products in the region contiguous to the shale operations can be expected to be relatively lower than they would be if similar petroleum products had to be shipped in.

It should again be emphasized, however, that development of an oil-shale industry to a scale sufficient to be of so much economic importance, will require much study, time and money. The oil-shale industry is no business for the man of little experience and small capital. It may be compared with the development of the low-grade copper ores of the West, in that it is a large, low-grade, chemical manufacturing enterprise, requiring capital, time, and trained men. The investor in oil-shale operations should know that he will probably have to wait for a long time for a return on his investment and that returns in all probability will be conservative. In spite of this, the day of the oil-shale industry is coming. When, it is difficult to predict, but some day it will undoubtedly be one of great importance. —U. S. Bureau of Mines, Reports of Investigations.

## Indicators for Carbon Dioxide and Oxygen Air and Flue Gas

The Bureau of Mines has recently issued Technical Paper 238, "Indicators for Carbon Dioxide and Oxygen in Air and Flue Gas," by L. H. Milligan, D. O. Crites and W. S. Wilson. The report describes the construction and method of using three types of portable indicators developed by the Bureau of Mines in its chemical research laboratory at the Pittsburgh station, one for determining the $CO_2$ content in air, one for determining $CO_2$ in flue gases, and the third for determining oxygen in air.

There is a distinct need for simple, compact, portable instruments that will indicate quantitatively the proportions of $CO_2$ and of oxygen in air that people who work in confined places must breathe. Apart from the presence of toxic gases like carbon monoxide, the greatest danger to men working in inclosed places comes chiefly from an increase in carbon dioxide or decrease in oxygen content of the air breathed. These conditions generally accompany each other, as processes of organic oxidation convert the oxygen of the air into carbon dioxide. For example, in a coal mine the breathing of men, the burning of miners' lamps, and the surface oxidation of coal and of timbers take oxygen from the air and add carbon dioxide to it. When a man breathes air containing more than 2 per cent carbon dioxide for any length of time, his working efficiency is reduced, and he is in considerable danger when the air contains more than 4 per cent carbon dioxide, or less than 13 per cent oxygen. Instruments with which carbon dioxide and oxygen can be conveniently determined will give warning of danger in time to avert it.

Such instruments are useful for testing the oxygen and carbon dioxide content of air in confined ill ventilated places in mines, in entering old workings, for use in rescue and exploration work after a mine disaster, or in exploring a mine or part of a mine that has been sealed off. They are also useful for determination of air in close spaces in industrial plants, in the hulls of ships, and in submarines, or in fact, vitiated air in any place where men must go or work.

Fuel is burned most efficiently when the oxidation is complete, and in burning coal, coke, petroleum, natural gas, or other fuels, this condition is most nearly attained when the flue gases have a high carbon dioxide content. Hence in a power plant frequent determination of the carbon dioxide in the flue gas is necessary in order to know what results the furnace is getting and in order to operate it intelligently.

Analyses of air or gas are made in the laboratory with stationary apparatus, but in the field portable types must be used. Various devices have been devised and marketed, but in general they have been bulky, heavy, more or less fragile, and require a trained chemist to operate them. The Bureau of Mines instruments have been designed chiefly with a view to overcoming these objections.

## 65-Cent Raise for Sturgis

### Plant's Closing Enhances Citizens' Appreciation of Gas Service

Sturgis, Mich., July 19, by a vote of 761 to 174, authorized the Sturgis Gas Company to increase its rate to $1.90 a thousand feet. The old rate was $1.25.

The increase ends a two-year controversy between the company and the city council. The voters June 14 rejected the company's request for a service charge of $1 a meter. The company closed its plant two days later and the city was without gas for three weeks.

The rate of $1.90 was recommended by a committee from the Rotary Club, which investigated the company's books.

# Peterson Begins Selling by Telephone

By S. G. Addison

Peterson has just completed a very thorough investigation and had discovered some very surprising and apparently contradictory things. In fact his discoveries were so surprising that he decided to talk over this man Jones with the Old Man before he tried out his new scheme. So the next time he had to take up other business with him and had finished with that he asked the Old Man if he had ever looked into the record of Jones.

"I haven't given it any special attention," replied the Old Man, "but as I remember his record it was one of the best on the sales force. Jones has been with us for a long time and his record has been very consistent."

"I found that out when I first came here," said Peterson, "and that made the things I have learned recently even more surprising. You know, of course, that Jones has a brother who is in the real estate business. A couple of weeks ago I had occasion to visit this office about a house he has for sale and I am thinking of buying. I found Jones there though it was the middle of the forenoon and his district is a couple of miles away. That afternoon as I was driving up the street I noticed Jones going into a moving-picture theater. I was positive that he had never been out to his territory. Of course I did not expect that he would turn in any orders. Imagine my surprise, therefore, when he turned in his regular number of sales.

"At first I thought these were phony sales and waited for complaints or rejections by the consumers. But they were perfectly good orders. I then compared the signatures appearing on the orders with those on the gas meter applications. It so happened that the signature on one of the orders purported to be the same as the signature on the meter application card. It was not the same.

"I then went over Jones' past record, secured the contracts he had turned in and compared the signatures. We found very many that bore signatures which it was apparent had never been written by the consumer. Some of the signatures were O. K., but most of them seemed to be faked. The faking, however, was apparently done by some one other than Jones. He seemed to have had an accomplice.

"In spite of the fact that the signatures were not genuine the orders were good. We haven't another man on the force with a record so free from cancellations as is that of Jones. I can tell you that I was puzzled. From what I had been able to learn about the activities of Jones it seemed that he rarely ever worked more than half a day if he worked that much. I was positive that there were many days that he never even went near his territory, yet every day rain or shine, good times or bad, he would turn in practically the same amount in sales and these were good sales. The sales were genuine, but that seemed to be the only genuine thing about the work of Jones.

"You know that for several years Jones has been working in a residential district in one of the best sections of the city. His brother does most of his real estate and insurance business in the same section. There might be a clue there, but I could not find anything I could follow up with satisfactory results. I then decided to study his sales once more and to study them more carefully. I had the originals of the orders he had turned in for the past month brought to me. I also sent for the fitters who had done the work. The fitters reported that in each case the consumer expected the appliances and that they were entirely satisfied. I asked these fitters what sort of houses most of the orders secured by Jones came from. They replied that they were always nice houses and fine people. They considered that the business Jones secured was the best secured by the company.

"I questioned them some further, studied the original orders, learned that most of the genuine signatures were those of men who had places of business downtown and wondered how Jones did it. Just then the telephone rang and there was a fellow on the line trying to sell me some stock in a new company he was interested in.

"I didn't buy any stock, but the incident did give me a clue. Perhaps Jones was using the telephone. I had each of the addresses on the orders looked up in the telephone directory and sure enough each had a telephone. Apparently I was on the right track. I investigated farther and this is what I learned. Jones rarely ever went out to his territory. He was able to get a good deal of information from his brother in regard to the conditions in his territory. A close reading of the newspaper and building reports kept him posted in regard to changes and building operations. The telephone did the rest. Jones has developed into a very clever telephone salesman. It never required more than two or three hours at the most for him to secure orders which would make his sales compare very favorably with those of any other man on the force. Occasionally he would visit the man of the house downtown here. But unless it was a large order he never bothered about that. He just had the stenographer sign the order. He could secure results so quickly and so easily in this way that he always had a half day to himself. After I had secured enough information to be sure I was right I had a talk with Jones and he admitted that he never made any calls and told me the details of his method."

"Did you fire him?" asked the Old Man.

"I could not see why I should fire one of our best salesmen just because he was smart enough to find a way out to cut down the time and effort required to get the desired results by at least fifty per cent. We talked the matter over and have worked out a plan whereby we can secure the full time of Jones rather than half of his time only. He has shown me how easy it is to sell goods over the telephone. He has practised the art so long that he has become expert. He has shown me how to secure as many orders in a couple of hours as a man making house to house calls could possibly secure in a day.

"I am organizing and placing him in charge of a department in which all the selling will be done over the telephone. I have also agreed to increase his salary to keep step with his increase in sales.

"It first I was tempted to fire him. It seemed the natural thing to do. He was not working according to rules at all. But his orders were all good. He was getting the results we wanted our salesmen to get, but wasn't getting them according to rule. He had used his head and had worked out a quicker and an easier way. The results were exactly as good but the work was not nearly as hard. He really had a better way of going about it than we had. Why should I fire a man because he had found a better way? Wouldn't it be better to keep that man and take advantage of his brains? He is likely to work out other methods which will reduce the work of selling and will increase sales. He is a bright, capable fellow and although he is always looking for the easiest way to get them he never fails to get satisfactory results.

"He has become a skilled salesman over the telephone. He has been practising the art for some time. The reason why his brother allowed him to use his telephone was because he was able to close many real estate deals for him over the telephone. I believe that he is too good a man to lose and as the facts which I had dug up made it necessary either to fire him or promote him I promoted him. Wouldn't you have done the same under the circumstances?"

"I did do practically the same thing when I hired you," dryly answered the Old Man.

AUTO PARK
UNION-PERFECTION GASOLINE
W.H. CAIN GAS RADIATOR CO.
HEAT YOUR HOME for 1 Cent an HOUR
MADE IN LOS ANGELES. PATENTED.

FLOAT OF THE W. H. CAIN GAS RADIATOR CO. IN LOS ANGELES, CAL. INDUSTRIAL PARADE

## Worcester Company Would Offer 8 Per Cent for New Money

The Public Utilities Commission gave a hearing July 21 on a petition of the Worcester Gas Light Company for permission to issue $350,000 worth of additional preferred stock carrying an 8 per cent dividend assurance.

Francis H. Dewey, representing the company, stated that the company needed more money and considered this to be the only available means of getting it. He said it was planned to sell the stock at par to present stockholders and to use the proceeds to reduce the floating indebtedness and for new construction.

City Solicitor John W. Mawbey and Mayor Peter F. Sullivan represented the city at the hearing and stated that the position of the city would be to oppose the request if it meant an increase in the price of gas to consumers.

No decision was given by the commission.

## New Gas Plant at Ripon

The Central Wisconsin Utilities Company has purchased the Karl Mueller land on Pacific Street, Ripon, Wis., where it will erect a modern gas plant. No statement has been made when the company will start work on the erection of the new plant.

The present gas plant is one of the first ones built in Wisconsin and is of obsolete type. The new plant will be modern in every respect and will produce high-pressure coal gas.

The company was thinking at one time of extending a pipe line to Ripon from its plant at Berlin, but this idea has been given up.

## Haverhill Employees Hold Outing

The seventh annual outing of the Haverhill (Mass.) Gas Light Company was held at Hampton Beach, Mass., July 20. The picknickers left Haverhill in two special cars at 8 o'clock and arrived at the beach at 9.45 a. m., and sports were immediately in order.

The winners of the sporting events, with prizes received, follow:

Baseball game—Works department beat office 3 to 0.

Fifty-yard girls' race—Won by Miss Florence Sargent; prize, lingerie pins.

Fifty-yard boys' race—Won by William Fitzgerald; prize, tie clasp.

Baseball throwing—Won by Mrs. J. W. Murphy; prize, silver bar pin.

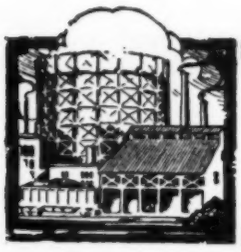
Potato race—Won by Richard Smith; prize, stick pin.

Three-legged race—Won by Roberts and England; prize, cuff links.

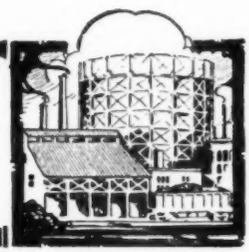
U and I race—Won by Gilman and Brown; prize, cuff links.

Meter-reading contest—Won by William H. Thompson; prize, silver pencil.

Dinner was served at the Hotel Pelham and was enjoyed by all. J. W. Christian was chairman of the general committee and M. Cannon chairman of the sports committee. Returning the 7 o'clock car was taken at the beach. It was declared the best outing ever held by the company.



# NEWS OF THE GAS INDUSTRY



## Consolidated of New York Authorized to Charge $1.20 a Thousand Cubic Feet

### U. S. District Court Judge Sets Down Eight Per Cent. Return on Valuation as Reasonable—New Rate in Effect at Once

One-dollar-and-twenty-cent gas was authorized in Manhattan by a decree filed Wednesday in the United States District Court by Judge Learned Hand. Judge Hand confirmed the report and recommendations of Special Master A. S. Gilbert, appointed by Federal Judge Julius S. Mayer in May, 1918, to take testimony and submit findings in the injunction suit of the Consolidated Gas Company of New York against Charles D. Newton, as Attorney-General of the State of New York; Edward Swann, District Attorney of New York County; Lewis S. Nixon and the Public Service Commission of this district.

The decree declares the present 80-cent gas rate under Chapter 125 of the laws of 1906 to be confiscatory and unconstitutional. The new rate goes into effect at once under these conditions:

1. An injunction against the defendants is granted to restrain them for a period of five years from suing on any penalty or forfeiture under the statute of 1906.

#### Trustee Named

2. Richard Welling is appointed as trustee for all the moneys collected as the difference between the old and the new rate, with directions to impound the additional 40 cents for each 1,000 cu. ft. and to hold the same until some competent "rate-making authority" shall prescribe a new rate and the rate-making authority, presumably the Legislature, is given until March 1, 1921, in which to enact new rate-making regulations.

3. If the decree is reversed by the United States Supreme Court, or if a "competent authority" promulgates a new gas rate prior to March 1, 1921, the additional 40 cents for each 1,000 cu. ft. is to be refunded to consumers, provided a reduction is authorized in the $1.20 rate to the extent of that reduction.

4. If a "competent rate-making" power fails to prescribe a new rate between now and March 1, 1921, the Consolidated shall keep all of the impounded moneys.

The defendants, it has been announced, will take immediate steps to prosecute an appeal from the decree.

#### Valued at $77,000,000

Reviewing the litigation between the Consolidated and the State and county authorities, including the Public Service Commission, since the first injunction proceedings were instituted several years ago to declare the law of 1906 unconstitutional and void, Judge Hand says that the present suit was inaugurated by the Consolidated after the United States Supreme Court dismissed a decree of the United States Circuit Court of Appeals in favor of the Consolidated and the case went back for retrial.

Mr. Gilbert's finding that the valuation of the Consolidated property, including its franchises, is $77,000,000 and that it distributes 19,000,000,000 cu. ft. of gas to its consumers during a year is accepted by the court, and the $1.20 rate is authorized in the decree because this increase over the present rate will enable the company to receive a return of 8 per cent on its valuation.

The income for the current year, which the court finds to be $900,000, is a return of but 1.2 per cent on the company's valuation, and the present net cost of delivering gas is found to be 75.18 cents for 1,000 cu. ft., based "on a full year's operation in 1918 and the first eight months of 1919." The court holds that prices for labor and material had "become higher in 1919 than during twenty previous months."

"We, in this country," the decree recites, "are not only influenced by conditions in Europe, but we are subject to our own local inflation and disorganization of industry, from which no one can know when we shall recover.

"The plaintiff is faced with a condition which permits it to receive much less than the return which the statute contemplated and which the constitution is thought to insure it. That condition, though probably not permanent, is bound to extend over a period of some years, at least, in coal, oil and labor, which are plaintiff's chief costs."

The decree then calls attention to the "higher and rising price levels between Jan. 1, 1918, and Aug. 1, 1920."

On the basis of the $1.20 rate a gross return of $7,600,000 will be realized on the company's valuation of $77,000,000, says the decree.

"Any hardship to the public," the decree holds, "appears to me to be answered by the plaintiff's inability for any period to escape the jurisdiction of the State authorities.

"I have provided that, if the State does not act before March 1, 1921, this plaintiff shall have all the fund and shall be free to charge what it pleases. Such inaction would indicate that the State was contented to leave the matter in that form if the decree were affirmed. If so, I should, of course, no longer interfere with the plaintiff in its pursuit of its rights."

#### Fight Bronx Raise

At the office of the Public Service Commission it was stated that immediate steps would be taken to prevent the Bronx Gas & Electric Company from charging its consumers $1.75 for each 1,000 cu. ft.

for illuminating gas, owing to numerous complaints which have been received by the commission recently.

These complaints say that the company has notified its consumers that the $1.75 rate will go into effect as of Aug. 1, 1920. A schedule of this rate was filed with the commission early last month, but the commission refused to accept the schedule, on the ground that it was in excess of the statutory limitation of $1 for 1,000 cu. ft., which has not been declared to be confiscatory, and because the proposed rate would be in violation of the order of Supreme Court Justice Mullan in the suit of the company against the commission on Aug. 1, 1919.

In its application for an injunction the company declared that it cost $1.50 to manufacture and distribute each 1,000 cu. ft. of gas. The company has been charging a rate of $1.50 for several months.

## Winchester Provides for Better Service Than Ever Before

With the completion of the new 100,000 cu. ft. holder recently finished for them by the Western Gas Construction Company, of Fort Wayne, Ind., the officials of the Union Light, Heat & Power Company, of Winchester, Ind., are confident that they can give their customers much better service during the coming winter.

They find that their supply of natural gas is able to take care of the daily send-out. With the aid of the gas stored in the holder available for the hours of heavy demand, the company will be able to give its patrons better service than they have ever had before.

Pacific Gas & Electric Company, San Francisco, Cal., in its annual report for last year shows after payment of interest and charges a surplus amounting to $3,340,353, as compared with $3,071,303 in 1918, an increase of $269,050. After the payment of $1,528,961 in dividends on the preferred stock, dividends amounting to $1,708,095 were paid on the common stock outstanding. In 1918 no dividends were paid on the common.

## Special Design Coal Hoist Solves Difficult Problem in Adding to Plant Capacity

When the contractors for the new water-gas plant for the Carolina Power & Light Company, Raleigh, N. C., were given a difficult problem in the installation of a complete modern water-gas set in the space between a battery of boilers and an existing building wall, they turned to the Western Gas Construction Company, of Fort Wayne, Ind., for aid, with the most favorable results.

By providing a special design of coke hoist, the latter firm was enabled to take care of the situation. The new machine has recently been put in operation and has proven very satisfactory.

## Massachusetts Gas Earnings Drop Slightly

The combined net earnings available for dividends of the Massachusetts Gas Companies for June were $300,595, a decrease of $5,945, or 1.94 per cent, compared with the corresponding month a year ago.

The June earnings show this:

| Gas department— | 1920 | 1919 | 1918 |
|---|---|---|---|
| Boston | $34,730 | $103,612 | $68,994 |
| East Boston | 7,994 | 3,259 | 10,793 |
| Quincy | 9,000 | 7,649 | 7,541 |
| Newton | 5,497 | 8,401 | 10,761 |
| Total | $57,223 | $122,922 | $98,091 |
| Coal department— | | | |
| N. E. Fuel & Trans. | 192,892 | 180,050 | 309,005 |
| N. E. Coal | 50,479 | 3,567 | 65,010 |
| Total | $243,372 | $183,618 | $374,015 |
| Grand total | $300,595 | $306,541 | $472,106 |

The net earnings of the subsidiary companies of the Massachusetts Gas Companies for the six months ended June 30, compare as below:

| | 1920 | 1919 | 1918 |
|---|---|---|---|
| Boston Consolidated | $493,599 | $642,816 | $555,861 |
| East Boston | 34,586 | 4,798 | 19,228 |
| Citizens | 30,893 | 30,118 | 30,016 |
| Newton & Watertown | 63,200 | 22,060 | 29,779 |
| Total | $622,280 | $699,794 | $634,886 |
| N. E. Coal & C. | 234,013 | 11,443 | 286,948 |
| N. E. Fuel & Trans. | 1,301,745 | 932,452 | 1,780,328 |
| Total | $1,535,759 | $943,895 | $2,067,277 |
| Grand total | $2,158,039 | $1,643,689 | $2,702,164 |

## Twenty-Three Per Cent of Customers Use Fifty Per Cent of Company's Output

The State Board of Public Utilities of Massachusetts recently gave a hearing at the State House, Boston, on the question of a service charge for gas and electric light companies, one of the principal witnesses being George H. Priest, general manager of the Brockton Gas Light Company.

Mr. Priest's testimony was based on statistics of gas consumption in Brockton and surrounding towns. Twenty-three per cent of the customers served by his company, he declared, use 50 per cent of the company's output, consequently pay vastly more in proportion than the small consumer.

Mr. Priest said that there were 8,046 in the district served by his company who used less than 1,000 cu. ft. of gas per month, and who in reality get their gas for practically nothing. The greater part of the cost thereby was borne by the large consumers, Mr. Priest submitted in arguing for a fixed service charge to reach the smaller customer.

## Albany Gas Company Allowed Increased Rate Under Temporary Injunction

Gas rates for Albany, Watervliet, Green Island and Colonie, N. Y., are advanced from $1.15 to $1.30 per 1,000 ft. under a new tariff schedule filed with the Second District, Public Service Commission, by the Municipal Gas Company of Albany. The new rate becomes effective Aug. 11.

Under the injunction granted by Supreme Court Justice Gilbert D. B. Hasbrouck, the gas company now has a $100,000 bond posted with the Public Service Commission as a guarantee of good faith that the company will return the excess charge to consumers should a case to decide the constitutionality of the dollar gas law be decided against the corporation. A decision in this case is now pending before Supreme Court Justice Charles E. Nichols.

Under the injunction as granted by Justice Hasbrouck the company was allowed to charge the $1.30 rate, but this rate was reduced voluntarily to $1.15 by the company several months ago. An appeal from the injunction has been taken and is due for argument at the September term, if Justice Nichols has not rendered a decision by that time, as to the constitutionality of the dollar rate.

Deputy Attorney General Chambers with Assistant Corporation Counsel John J. McManus of Albany fought the Albany gas rate increase since the movement was first launched by the company.

Due to the fact that Justice Hasbrouck's injunction allowed a $1.30 rate providing the company posted a bond to return the excess charges, it will not be necessary for the Municipal Gas Company to post another bond. This was the view taken of the situation by the Municipal Gas Company officials and the Public Service Commission.

"Greatly increased prices of gas oil and coal," was blamed for the necessity of raising the rates in a statement issued by Carl H. Graf, vice-president and general manager of the company.

A decision on the constitutionality of the dollar gas rate is believed to have been delayed by a recent illness of Justice Nichols. It required forty-three days to try the case before Justice Nichols. It has now been pending nearly nine months.

## New Water Gas Set Wanted at Wakefield

In a communication addressed to gas consumers of the municipality, the Wakefield (Mass.) Board of Municipal Light Commissioners strongly emphasizes the need of installing a new water-gas set at once.

## Lack of Coal Compels Shutdown at Dixon

Gas service at Dixon, Ill., was shut off July 14 at 1 o'clock in the afternoon and the plant was shut down for lack of coal to keep the retorts going. For several weeks frequent suspensions of service have resulted from the coal shortage.

Little relief is promised to the Dixon consumers until after Sept. 1, according to E. D. Alexander, general manager of the Illinois Northern Utilities Company.

The company is installing a new bench which will enable it to make gas at the Dixon plant regardless of the quality of coal used. The company is now dependent upon Eastern "gas" coal to run the plant.

## World's Deepest Gas Well

The world's deepest producing natural gas well is located about 60 ft. from the edge of the Lincoln Highway near Ligonier in Westmoreland County, Pennsylvania. This well with a depth of 6,680 ft. flows 500,000 ft. of natural gas per day, and is one of the interesting sights inspected by tourists on the transcontinental road in the Keystone State.

Ligonier, Ind., was named after the historic Pennsylvania town.

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AW GEE MA - I GOT A SWIMMING DATE
They are pleased
GALENA'S GASLESS PLANT
GAS
MORE
METER
WHEN I'M OUT I'M DOWN AND WHEN I'M DOWN I'M OUT

AMERICAN GAS ASSOCIATION DRAWS A MORAL FROM GALENA'S PLANT